APx515
audio analyzer

Installation Instructions
and Specifications

Audio precision

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Installation Instructions and Specifications

model APx515

Audio precision

October, 2013

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Documentation and Support

This booklet contains safety information, installation instructions and full specifications for the Audio Precision APx515 audio analyzer.

The APx500 User's Manual

Detailed information on the operation of the APx515 analyzer is available from the online Help installed with the APx500 measurement software, and in the APx500 User's Manual. The user's manual is available as a PDF on the APx500 Application Disc and on the Web at ap.com; a hard-copy version can be ordered from Audio Precision or your local distributor.

Audio Test Discs

These discs and more can be ordered from Audio Precision or your local distributor.

- APx-DVD1 is a playable video DVD with menu-driven linear and coded audio test signals for external source use with DVD players.
- APx-CD1 is a playable audio CD with linear audio test signals for external source use with CD players.
- APx-BD1 is a playable Blu-ray Disc with menu-driven high-resolution linear and coded audio test signals for external source use with Blu-ray Disc players.

ap.com

Visit the Audio Precision Web site at ap.com for APx support information. APx resources are available at ap.com/downloads/apx. You can also contact our Technical Support staff at techsupport@ap.com, or by telephoning 503-627-0832 extension 4, or 800-231-7350 extension 4 (toll free in the U.S.A.).

Safety

Safety Information

Do NOT service or repair this equipment unless properly qualified. Servicing should be performed only by a qualified technician or an authorized Audio Precision distributor.

Do NOT defeat the safety ground connection. This equipment is designed to operate only with an approved three-conductor power cord and safety grounding. Loss of the protective grounding connection can result in electrical shock hazard from the accessible conductive surfaces of this equipment.

Do NOT exceed mains voltage ratings. This equipment is designed to operate only from a 50–60 Hz ac mains power source at 100–240 Vac nominal voltage. The mains supply voltage is not to exceed ±10 % of nominal (90–264 Vac).

For continued fire hazard protection, fuses should be replaced ONLY with the exact value and type indicated on the rear panel of the instrument and discussed on page 10 of this booklet.

The International Electrotechnical Commission (IEC 1010-1) requires that measuring circuit terminals used for voltage or current measurement be marked to indicate their Measurement Category. The Measurement Category is based on the amplitude of transient or impulse voltage that can be expected from the AC power distribution network. This product is classified as Measurement Category I, abbreviated “CAT I” on the instrument front panel. This product should not be used within Categories II, III, or IV. The APx515 measurement terminals are rated for a maximum input of 125 Vpk, 88 Vrms and are intended to be used for the measurement of audio signals only.

Do NOT substitute parts or make any modifications without the written approval of Audio Precision. Doing so may create safety hazards. Using this product in a manner not specified by Audio Precision can result in a safety hazard.

This product is for indoor use—Installation Category II, Measurement Category I, pollution degree 2.

To clean the enclosure of this product, use a soft cloth or brush to remove accumulated dust. A mild detergent may be used to remove remaining dirt or stains. Do not use strong or abrasive cleaners. Wipe all surfaces with a damp cloth.

This unit is supplied with four feet on the bottom surface and four feet on the right side surface. The unit should only be operated while resting on the bottom surface feet. The feet on the right side are provided for convenience and stability when transporting the unit. DO NOT operate the unit while it is sitting on the side feet.

Safety Symbols

The following symbols may be marked on the panels or covers of equipment or modules, and are used in this manual:

WARNING!—This symbol alerts you to a potentially hazardous condition, such as the presence of dangerous voltage that could pose a risk of electrical shock. Refer to the accompanying Warning Label or Tag, and exercise extreme caution.

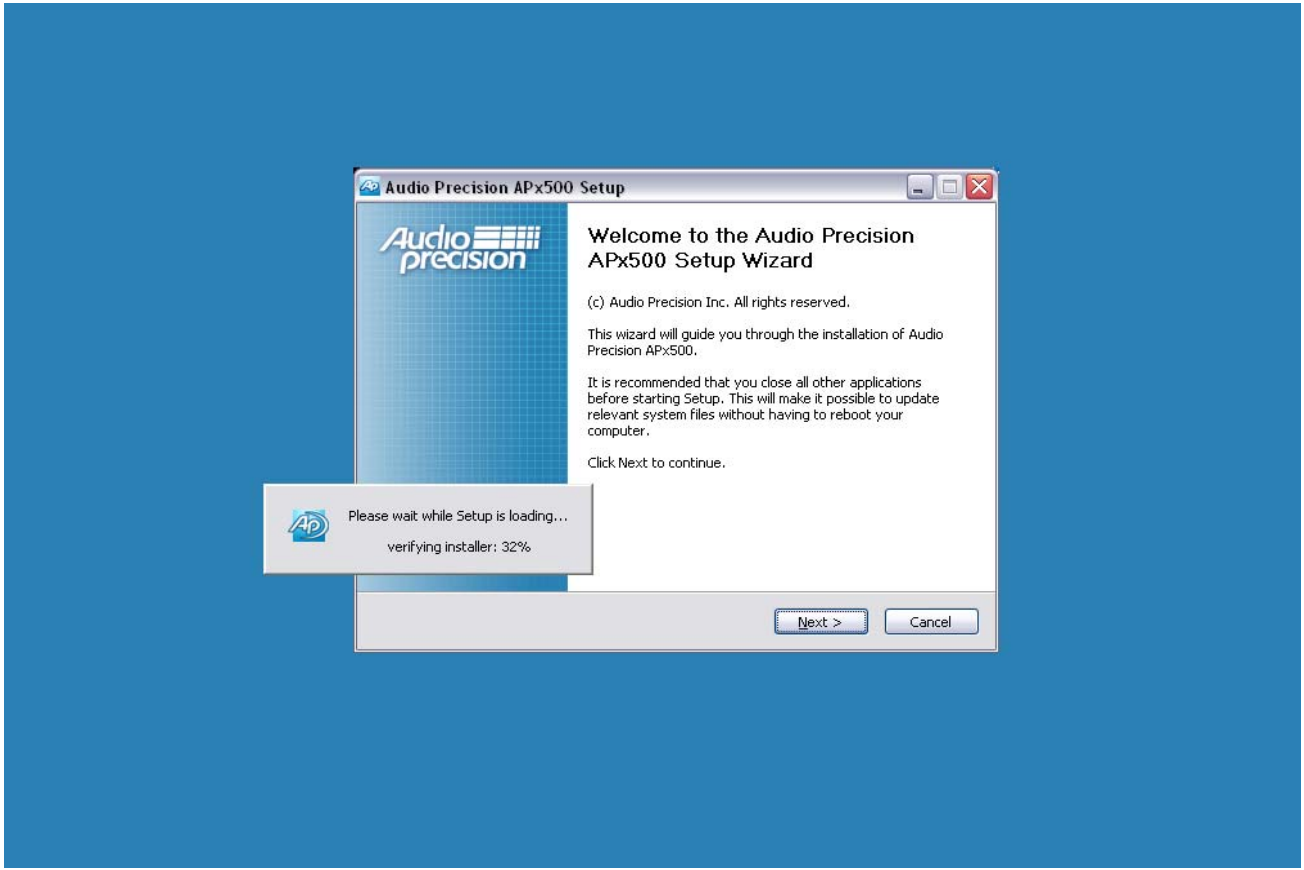
ATTENTION!—This symbol alerts you to important operating considerations or a potential operating condition that could damage equipment. If you see this marked on equipment, refer to the Operator's Manual or User's Manual for precautionary instructions.

FUNCTIONAL EARTH TERMINAL—A terminal marked with this symbol is electrically connected to a reference point of a measuring circuit or output and is intended to be earthed for any functional purpose other than safety.

PROTECTIVE EARTH TERMINAL—A terminal marked with this symbol is bonded to conductive parts of the instrument and is intended to be connected to an external protective earthing system.

Disclaimer

Audio Precision cautions against using their products in a manner not specified by the manufacturer. To do otherwise may void any warranties, damage equipment, or pose a safety risk to personnel.


Audio Precision APx500 Setup
Welcome to the Audio Precision APx500 Setup Wizard
(c) Audio Precision Inc. All rights reserved.
This wizard will guide you through the installation of Audio Precision APx500.
It is recommended that you close all other applications before starting Setup. This will make it possible to update relevant system files without having to reboot your computer.
Click Next to continue.
Please wait while Setup is loading...
verifying installer: 32%
Next >
Cancel

Installation

Software

The APx515 audio analyzer system uses the award-winning APx500 measurement software. This is the same software used in the APx525and APx585 analyzer families.

PC system requirements

The APx500 measurement software requires a personal computer (PC) with the following features and capabilities:

- Operating system: Microsoft Windows 8, Windows 7, Windows Vista, or Windows XP Professional (Service Pack 2 or later).
- A multi-core processor (at least dual-core) running at a clock speed of at least 2 GHz. Most current processors from Intel and AMD meet these requirements.

Note: the Intel Atom processor does not meet our minimum specification.

- At least 2 GB of RAM.
- At least 300 MB of free hard disk space.
- A CD-ROM optical disc drive.
- A USB 2.0 port; two are required for optional switcher use.
- A color monitor and a video card with at least VGA capabilities. Video resolution of 1024 x 768 or greater is recommended.

System performance is sensitive to processor speed; faster processors will yield faster results.

APx500 is data intensive and it is recommended that other data-intensive applications not be run concurrently. This includes Audio Precision's AP2700, APWIN or ATS.

Installation

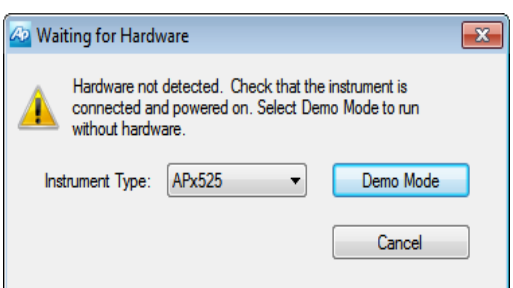
To install the measurement software, insert the APx500 CD-ROM into the optical drive on the PC and follow the instructions in the installation dialog.

NOTE: You must have local administrator rights to install APx500 software. Go to User Accounts in the Windows Control Panel, or check with your network administrator.

Running the software without instrument hardware attached

NOTE: You must have standard user rights or administrator rights to operate APx500 software. Guest users are not supported.

You can launch the APx500 software without instrument hardware attached. When no hardware is detected, APx500 will present you with the following dialog box:


Waiting for Hardware
Hardware not detected. Check that the instrument is connected and powered on. Select Demo Mode to run without hardware.
Instrument Type:
APx525
Demo Mode
Cancel

Select "Demo Mode." APx500 will run in demo mode, which allows you to explore the user interface but does not enable any measurement functions. Input data shown in Demo Mode is false data, generated for display only.

At first launch, Demo Mode runs simulating attachment to an APx585. To run Demo Mode simulating an APx515 or other instrument, select that option from the Instrument Type menu.

Running the software with instrument hardware attached

NOTE: You must have standard user rights or administrator rights to operate APx500 software. Guest users are not supported.

Connecting the instrument to your PC

Before connecting your APx515 instrument to your PC, install the APx500 measurement software as described above. Connecting the instrument prior to software installation may cause Windows to select an incorrect USB driver for the instrument.

USB driver selection

The measurement software communicates with the APx515 using a USB 2.0 interconnection. Once the software is successfully installed, connect one end of the USB cable to a USB 2.0 port on the PC, and the other end to the PC INTERFACE port on the rear of the APx515. We strongly recommend that you use the USB cable included with your instrument (AP part number CAB-APSI). We have tested other USB cables that perform poorly.

Note: Some PCs have optional USB ports on the front of the PC, or on extension brackets on the rear. In many cases these convenience ports have compromised performance due to the extra

cable length within the PC. We recommend using USB ports directly connected to the PC motherboard, typically at the rear of the PC.

Connect the APx515 mains power cord to the instrument and to a source of ac mains power. See **Setting up the hardware** below for more information about mains connections.

Turn the instrument on by rocking the mains power switch up to **ON** (|). The mains power switch is located in the power entry module on the rear of the APx515. Windows will detect the presence of the APx515 on the USB port and will open the Hardware Update Wizard to search for the correct software driver. Select "Install the software automatically." Windows will find the Audio Precision driver software installed with APx500 and connect to the APx515.

Launch APx500 by double-clicking on the installed shortcut. With the APx515 connected, you may be asked to update the instrument firmware during the first launch of the measurement software. APx500 will start, and in a short time you will be presented with the opening screen. Refer to the APx500 User's Manual for more information about making measurements.

The APx500 User's Manual is available as a PDF on the APx500 Application Disc and online at ap.com; a hard-copy version can be ordered from Audio Precision or your local distributor.

Setting up the hardware

Connecting your instrument to the electrical mains supply

The APx515 instrument must be connected to a 50–60 Hz alternating current (ac) electrical mains supply, maximum voltage 250 Vrms.

The instrument has been configured at the factory for the expected voltage at its intended destination, as ordered. The voltage setting and fusing arrangement will normally be correct unless the instrument has been transported into another area. The power entry module has a strip of indicator tape showing its mains voltage setting. This tape must be removed before use.

*You **MUST** be sure that the APx515 instrument mains power configuration is correct for the electrical mains power supplied in your area. If you are not sure, do not plug the instrument into the mains power. Follow the instructions below to check or change the instrument mains supply voltage selection.*

The mains power supply is applied to your APx515 instrument through the power entry module located on the rear panel. Before connecting the power cord, confirm that the

input voltage selection and fusing arrangement in the power entry module are correct for your mains power supply.

Figure 2. Detail, power entry module on APx515 instrument rear panel. The mains power switch is to the left.

Checking the mains supply voltage configuration

The white plastic voltage indicator pin protrudes through one of the four labeled holes in the module cover to indicate the selected input voltage. Figure 2 shows the pin in the second position, indicating 120 V. Check to see that the indicated voltage matches your mains supply voltage. If it does not, change the mains supply voltage configuration as described below.

Opening the power entry module

Unplug the power cord from the instrument before changing fuses or performing any other operations described in this section.

To open the power entry module, refer to Figure 3 and proceed as follows:

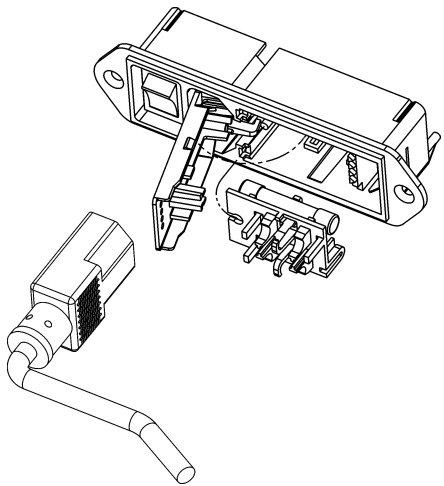


Figure 3. Power entry module door and fuse block.

- Remove the mains power supply cord from the power cord connector.
- Locate the slot in the module cover door hinge. The hinge is a the left side of the cover door, and the slot in the hinge is visible in the power cord connector cavity. Insert a small screwdriver or similar tool in the slot and pry the cover door hinge outward. The cover door will snap out, and then can be pivoted on its hinge for access to the fuse block assembly and voltage selector card.

Changing the Mains Supply Voltage Configuration

- Open the Power Entry Module as described above.
- The voltage selector card is a small circuit board fitted with a white plastic indicator pin, installed in a housing on the right side of the Power Entry Module as shown in Figure 4. Pull the voltage selector card straight out of the housing, using narrow pliers to grab the card. Do not use the indicator pin as a handle.

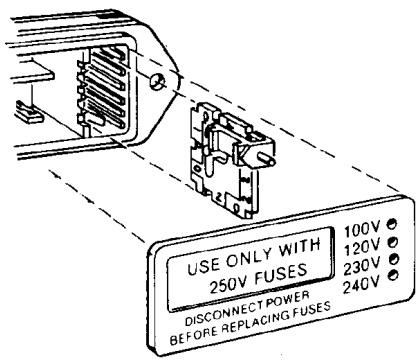


Figure 4. Changing the mains power supply voltage.

- Orient the selector card so that the desired input voltage is readable at the bottom, shown in Figure 5. Then move the indicator pin to point UP, opposite the indicated voltage. Seat the pin assembly in the notch on the board edge.
- Insert the voltage selector card into the housing with the printed side of the card facing toward the mains power connector. The card edge indicating the desired voltage should enter the housing first.
- Confirm that the correct fuse or fuse combination is installed for the intended input voltage (refer to the fuse ratings marked on the instrument rear panel). If necessary, change the fuse type as described in the following section.

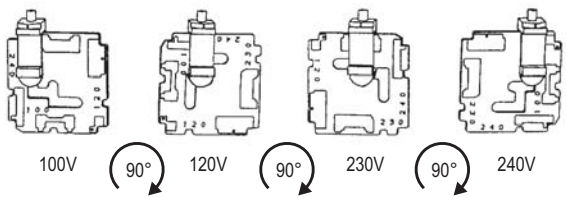


Figure 5. Voltage card selector orientation.

- Close the module the cover door and verify that the indicator pin shows the desired voltage.
- Once you have verified that the line voltage selection is correct, connect the power cord from a mains power outlet to the power cord connector on the instrument rear panel.

Fuse information

The power entry module accommodates two fusing arrangements, as illustrated in Figure 6.

100/120 VAC operation

The 100/120 VAC fusing arrangement uses a single type 3AG (0.25" x 1.25") slo-blo fuse. Audio Precision recommends only the following replacement fuse:

- 1 each Littelfuse 313 Series, 600 mA 3AG 250 V slo-blo glass fuse.

230/240 VAC operation

The 230/240 VAC fusing arrangement uses two 5 x 20 mm IEC-approved type T fuses. Audio Precision recommends only the following replacement fuses:

- 2 each Littelfuse 213 Series, 315 mA 250 V 5 x 20 mm Time Lag (slo-blo) glass fuses
  or
- 2 each Littelfuse 218 Series, 315 mA 250 V 5 x 20 mm Time Lag (slo-blo) glass fuses.

Refer to the label on the instrument rear panel for fuse current ratings.

Changing the fusing arrangement

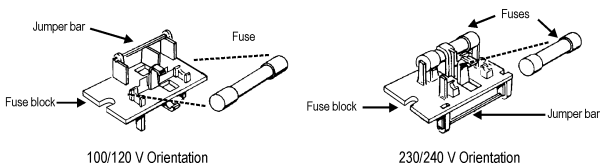


Figure 6. Fuse block orientation for 100/120 VAC and 230/240 VAC operation.

To replace a fuse or change the fusing arrangement, proceed as follows:

- Remove the mains power cord from the power cord connector and open the Power Entry Module as described above.
- Using narrow pliers, pull the fuse assembly out of the housing.
- Change or add the correct fuses as necessary, referring to Figure 6. Refer to the instrument rear panel for the correct fuse electrical current rating.
- Insert the fuse assembly in the housing, with the side of the assembly that carries the fuse(s) for your desired fusing arrangement facing into the housing. Press the fuse assembly firmly into the housing.
- Confirm that the line voltage selection is correct for your mains voltage and your fusing arrangement.

Once you have verified that the line voltage selection is correct, connect the power cord from a mains power outlet to the power cord connector on the instrument rear panel.

Abbreviations, Terms and Symbols

used in the following specifications

ADC or A/D	Analog to Digital converter.
BW	Bandwidth or Measurement Bandwidth, a single number indicates only the upper limit.
DAC or D/A	Digital to Analog converter.
DUT	Device Under Test, the device to which the generator or analyzer is connected.
EMC	Electro-Magnetic Compatibility, usually refers to both emissions (radiated and conducted via AC mains) and susceptibility.
FFT	Fast Fourier Transform, a mathematical process converting the time domain representation of a signal to the frequency domain.
IMD	Inter-Modulation Distortion, a measure of non-linearity using a test signal with two or more components.
rms	Root Mean Square, an equivalent-power expression of signal amplitude.
SR	Sample Rate, usually as it applies to the conversion rate of A/D and D/A converters.
THD	Total Harmonic Distortion, rms summation of d2 to d9 (may be bandwidth limited), usually derived from an FFT.
THD+N	Total Harmonic Distortion plus Noise, an rms measurement of ALL harmonics, spurious signals, hum, and noise within a specified bandwidth.
Typical or Typ	A characteristic that is not guaranteed, usually due to a practical limitation in testing or metrology.
[ ]	Bracket pair, indicates a specification in an equivalent unit, for example: 0.030 dB [0.35%] or 10.61 Vrms [30.0 Vpp].
+	Bold plus symbol, indicates rms summation (square-root of the sum of the squares) instead of arithmetic summation.
≈	Double tilde, indicates an approximate or nominal numerical value (or range of values) that may vary from unit to unit.

Specifications
APx515 audio analyzer

with APx500 v3.4 or higher measurement software
October 2013 NP0020.00014 r004

Characteristic	Specifications	Supplemental Information
ANALOG GENERATOR		
Number of Channels	2, independent amplitude control	
Waveforms	Sine, sine split frequency, sine split phase, sine+DC offset, continuously swept-sine, noise, IMD test signals, multi-tone, wave file playback	
Sine Characteristics		
Frequency Range (Fs)	2 Hz to 80.1 kHz	*Setting resolution is typically 45 µHz*
Frequency Accuracy	±(0.0003% + 100 µHz)	
Amplitude Range	0 to 16.00 Vrms [45.2 Vpp], balanced; 0 to 8.00 Vrms [22.6 Vpp], unbalanced	
Amplitude Accuracy, 1 kHz	±0.05 dB [±0.58%]	
Flatness (1 kHz ref)		
Fs = 10 Hz to 20 kHz	±0.010 dB	*Typically <0.005 dB.*
Fs = 20 kHz to 50 kHz	±0.030 dB	
Fs = 50 kHz to 80 kHz	±0.10 dB	
Residual THD+N[1,2]		
Fs = 20 Hz–20 kHz	≤ (–102 dB + 1.4 µV), 20 kHz BW	
Non-Harmonic Content		*Typically <-110 dB when Fs ≤75 kHz, increasing to ≈-55 dB at Fs =80 kHz*
Phase Offset Range (Split Phase)	–179.999 to +180.000 deg	

Characteristic	Specifications	Supplemental Information
DC Offset Range	±12.00 Vdc balanced; ±6.00 Vdc unbalanced	*DC offset limits maximum ac signal*
Residual DC Offset	≤0.25% of Vrms setting [≤0.09% of Vpp setting] + 100 µV	
Noise Characteristics		
Shape	White (<5 Hz to >80 kHz), Pink (<10 Hz to >80 kHz), IEC 60268-1 or BS EN 50332-1	
Amplitude Range	0 to 45.2 Vpp, balanced; 0 to 22.6 Vpp, unbalanced	*Amplitude calibration is approximate*
IMD Test Signals (requires option AML)		
SMPTE & MOD		
LF Tone Range	40 Hz to 1 kHz	
HF Tone Range	2 kHz to 20 kHz	*HF tone must be ≥ 6 • LF tone.*
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	*4:1 maximum with SMPTE signal.*
Amplitude Range	0 to 45.2 Vpp, balanced; 0 to 22.6 Vpp, unbalanced.	
Amplitude Accuracy	±0.06 dB [±0.70%]	
Residual IMD[1,2,3]	≤0.0025% [-92 dB], 4:1 mix ratio	
DFD		
Tone Pair Mean Range	2.5 kHz to 20 kHz	$F_{mean} = (F1 + F2)/2.$
Tone Pair Difference Range	80 Hz to 2.0 kHz	$F_{diff} = \|F2 - F1\|$ F_{mean} *must be* $\geq 6 \bullet F_{diff}$
Amplitude Range	0 to 45.2 Vpp, balanced; 0 to 22.6 Vpp, unbalanced.	
Amplitude Accuracy	±0.06 dB [±0.70%]	
Residual IMD[1,2,3]	≤ 0.0010% [–100 dB]	
Multitone, Wave File Playback (requires option HST)		
Sample Rate Range (SR)	8 kS/s to 108 kS/s, and 175 kS/s to 192 kS/s	*Operation from 109 kS/s to 175 kS/s is possible, but with degraded flatness*
Maximum File Size	32 MSample.	
Amplitude Range	0 to 45.2 Vpp, balanced; 0 to 22.6 Vpp, unbalanced.	*.Wav file must peak at digital full scale to obtain selected amplitude*

Characteristic	Specifications	Supplemental Information
Flatness (1 kHz ref)		
SR = 175 kS/s to 192 kS/sec		*Typically <0.012 dB to 20 kHz*
SR = 8 kS/s to 108 kS/s		*Typically <0.04 dB to 20 kHz; max frequency limited to ≈0.45 • SR*
Spurious Content		*Typically <–100 dB*
Output Equalization	Arbitrary 30-pole output filter, scaled so the maximum gain is –1 dB.	
Source Resistance (Rs)		
Balanced	Selectable 100 Ω ±1% or 600 Ω ±1%.	*Grounded, symmetrical*
Unbalanced	Selectable 50 Ω ±1.5% or 600 Ω ±1%.	*Electronically floating, 0.3 Vpk max; bnc shield to ground ≈10-17 Ω || 22nF*
Common Mode Test	Same as Balanced selections	
Max Output Current		*Typically >50 mA peak, 50 mA dc*
Reverse Overload Protection		*Up to 30 W*
Output Related Crosstalk[1]	≤ (–120 dB + 1 µV) to 20 kHz	
ANALOG ANALYZER		
Number of Channels	2, independently auto-ranging.	*Max ADC sample rate = 192 kS/s*
Maximum Rated Input	125 Vpk, 120 Vdc any input to ground; 0.5 Vpk for unbalanced bnc shields	
Input Impedance		
Balanced	100 kΩ || ≈230 pF, each side to gnd	
Unbalanced	100 kΩ || ≈230 pF to bnc shield	*Electronically floating, 0.5 Vpk max; bnc shield to ground ≈500Ω || 22nF*
Input Termination	Selectable 600 Ω ±1%, 1.5 W max.	*Termination automatically opens in the 80 V range.*
Input Coupling	Selectable DC or AC	*Typically <0.5 µA bias current with DC coupling, typically <0.03 dB roll-off at 20 Hz with AC coupling*
Input Ranges	250 mVrms to 80 Vrms, 10 dB steps	*Maximum ac signal is ≈88 Vac unbal, 115 Vac bal, in the 80V range*

Characteristic	Specifications	Supplemental Information
Common Mode Rejection[4]		*Max common mode signal range:*
250 mV, 800 mV, 2.5 V ranges	≥ 80 dB, 5 Hz to 5 kHz; ≥ 70 dB, 5 kHz to 20 kHz.	*±6 Vpk*
8 V range	≥ 50 dB, 5 Hz to 20 kHz	*±12 Vpk*
25 V range	≥ 50 dB, 5 Hz to 20 kHz	*±60 Vpk*
80 V range	≥ 45 dB, 5 Hz to 20 kHz	*±120 Vpk*
Input Related Crosstalk	≤ (–120 dB + 0.3 µV) to 20 kHz	*$R_s \leq 600\ \Omega$*
Level (Amplitude) Measurement		
Range		
Balanced or bridging input	< 1 µV to 115 Vrms	
Unbalanced input	< 1 µV to 85 Vrms	
Accuracy (1 kHz)	±0.05 dB [±0.60%]	
Flatness (1 kHz ref, DC coupling)		
10 Hz to 20 kHz	±0.010 dB	*Typically < 0.005 dB.*
20 kHz to 50 kHz	±0.030 dB	
50 kHz to 80 kHz	±0.10 dB	
Residual Noise (inputs shorted)	≤ 1.4 µVrms, 20 kHz BW	*Typically < 8.0 nV/√Hz at 1 kHz*
THD+N Measurement		
Fundamental Range	5 Hz to > 50 kHz	
Measurement Range	0 to 100%	
Accuracy	±0.5 dB	
Residual THD+N[1,2]		
20 Hz–20 kHz fundamentals	≤ (–102 dB + 1.4 µV), 20 kHz BW	

Characteristic	Specifications	Supplemental Information
Level & THD+N Filters		
High-Pass	5 Hz to 500 Hz, or None	*1 Hz steps*
Low-Pass[5]	1 kHz to the selected BW setting, or None	*100 Hz steps; very sharp roll-off characteristic exceeds AES-17.*
Weighting	A-wt, B-wt, C-wt, CCIR-1k, CCIR-2k, CCITT, C-message, 50 µs or 75 µs de-emph (with and without A-wt), or None	*Weighting filter is cascaded with the high-pass and low-pass bandwidth limiting filters*
IMD Measurement		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 2 kHz–20 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF)	*HF tone must be ≥ 6 • LF tone.*
DFD	Any two-tone combination with mean frequency of 2.5 kHz–50 kHz and a difference frequency of 80 Hz–2.0 kHz	F_{mean} *= (F1+F2)/2,* F_{diff} *= |F2–F1|.* F_{mean} *must be ≥ 6 •* F_{diff}
IMD Measured		
SMPTE	Amplitude modulation of HF tone.	*Measurement BW is typ. 40–500 Hz.*
MOD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC 60268*
DFD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC 60268*
Measurement Range	0 to 20%	
Accuracy	±0.5 dB	
Residual IMD[1,2,3]		
SMPTE & MOD	≤-92 dB [0.0025%], 4:1 mix ratio	
DFD	≤-100 dB [0.0010%]	
Frequency Measurement		
Range	5 Hz to 90 kHz	
Accuracy	±0.0003% [3 ppm]	V_{in} *must be ≥ 5 mV.*
Resolution	6 digits	

Characteristic	Specifications	Supplemental Information
Phase Measurement		
Ranges	–90 to +270, ±180, or 0 to 360 deg	
Accuracy	±0.2 deg, 5 Hz to 5 kHz; ±0.8 deg, 5 kHz to 20 kHz; ±2.0 deg, 20 kHz to 50 kHz	*V_{in} must be ≥ 5 mV with dc coupling, both channels. Accuracy degrades below 50 Hz with ac coupling.*
Resolution	0.001 deg	
DC Voltage Measurement		
Input Ranges	0.25 V to 80 V, 10 dB steps	*±120 Vdc maximum in 80 V range*
Accuracy		
250 mV and 800 mV ranges	±(0.7% reading + 1 mV)	
2.5 V-80 V ranges	±(0.7% reading + 0.1% range)	
Normal Mode Rejection		*Typically > 90 dB, 20 Hz to 20 kHz.*
DIGITAL I/O		
DIGITAL OUTPUT RELATED:		
Formats		
Electrical, unbalanced	SPDIF-EIAJ per IEC60958, 0.50 Vpp or 1.00 Vpp ±10% into 75 Ω	*Output R is nominally 75 Ω.*
Electrical, balanced	AES-EBU per AES3-1992, 5.00 Vpp ±10% into 110 Ω	*Output R is nominally 110 Ω.*
Optical	Toslink®	
Sample Rate (SR) **Range**	22 kS/s to 216 kS/s	
Sample Rate (SR) **Accuracy**	±0.0003% [3 ppm]	
Channel Status Bits	Full implementation per IEC-60958	*Automatically set or manual override, hex or plain English*
User Bits	Fully settable	*Hex*
Validity Flag	Set to 0	
Residual Jitter[1,6]		
Electrical		*Typically < 1.5 ns*
Optical		*Typically < 2.5 ns, SR ≤ 96 kS/s*

Characteristic	Specifications	Supplemental Information
EMBEDDED OUTPUT SIGNAL RELATED:		
Waveforms	Sine, sine split frequency, sine split phase, sine+DC offset, continuously swept-sine, square-wave, noise, IMD signals, multi-tone, constant value, walking ones/zeros, bittest random, wave file playback	*8–24 bit word width, triangular PDF dither.*
Sine Characteristics		
Frequency Range	5 Hz to 0.499 • SR	
Flatness[1]		*Typically <0.001 dB*
Offset Range	To maximum digital code [±1D]	*Offset limits maximum ac signal*
Harmonics & Spurious[1,6]		*Typically <–140 dBFS*
Square Characteristics		
Frequency Range (Fq)	10 Hz to SR / 6	*Only specific values are allowed: Fq = SR / N where N is an even integer ≥6*
Even Harmonic, Spurious Content		*Typically <-140 dBFS*
Noise Characteristics		
Shape	White (<5 Hz to 0.499 • SR), Pink (<10 Hz to 0.45 • SR), IEC 60268-1 or BS EN 50332-1	
IMD Test Signals		
SMPTE & MOD		
LF Tone Range	40 Hz to 1 kHz	
HF Tone Range	2 kHz to (0.499 • SR) or 20 kHz, whichever is lower	*HF tone must be ≥ 6 • LF tone.*
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	
Residual IMD[1,6]		*Typically <–140 dBFS*
DFD		
Tone Pair Mean Range	2.5 kHz to (0.499 • SR – F_{mean} / 2) or 20 kHz, whichever is lower	F_{mean} *= (F1 + F2)/2.*
Tone Pair Difference Range	80 Hz to 2.0 kHz	F_{mean} *= (F1+F2)/2,* F_{diff} *= |F2–F1|.* F_{mean} *must be ≥ 6 •* F_{diff}
Residual IMD[1,6]		*Typically <–150 dBFS*

Characteristic	Specifications	Supplemental Information
Multitone, Wave File Playback		
Sample Rate (SR)	8 kS/s to 216 kS/s	
Maximum File Size	32 MSample.	
Flatness (1 kHz ref)		*Typically <0.001 dB to 0.499 • SR*
Spurious Content		*Typically <–140 dB*
DIGITAL INPUT RELATED:		
Formats		
Electrical, unbalanced	SPDIF-EIAJ per IEC60958, ≤10 Vpp.	*Input R is nominally 75 Ω.*
Electrical, balanced	AES-EBU per AES3-1992, ≤10 Vpp.	*Input R is nominally 110 Ω.*
Optical	Toslink®	
Sample Rate Range (SR)	22 kS/s to 216 kS/s	*Typically locks down to 16 kS/s*
EMBEDDED INPUT SIGNAL RELATED:		
Level (Amplitude) Measurement		
Measurement Range	< –120 dBFS to +3 dBFS	
Accuracy (1 kHz)		*Typically < 0.001 dB*
Flatness[1]		*Typically <0.001 dB*
Residual Noise[1]		*Typically <–140 dBFS*
THD+N Measurement		
Fundamental Range	5 Hz to 0.49 • SR or 50 kHz, whichever is lower	*Tuning can be set to track measured frequency, generator setting or fixed*
Measurement Range	0 to 100%	
Accuracy	±0.5 dB	*Q=2.6 typically*
Residual THD+N[1, 7]		*Typically <–140 dBFS*
Level & THD+N Filters		
High-Pass Filter	5 Hz to 500 Hz, or None	*1 Hz steps*
Low-Pass Filter[5]	1 kHz to 97.2 kHz, or None	*100 Hz steps; very sharp roll-off characteristic exceeds AES-17*
Weighting	A-wt, B-wt, C-wt, CCIR-1k, CCIR-2k, CCITT, C-message, 50 µs or 75 µs de-emph (with and without A-wt), or None	*Weighting filter is cascaded with the high-pass and low-pass bandwidth limiting filters*

Characteristic	Specifications	Supplemental Information
IMD Measurement		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 2 kHz–20 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF).	*HF tone must be ≥ 6 • LF tone.*
DFD	Any two-tone combination with mean frequency of 2.5 kHz–50 kHz and a difference frequency of 80 Hz–2.0 kHz.	*F_{mean} = (F1+F2)/2, $F_{difference}$ = |F2–F1|. F_{mean} must be ≥ 6 • |F2–F1|.*
IMD Measured		
SMPTE	Amplitude modulation of HF tone.	*Measurement BW is typ. 40–500 Hz.*
MOD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC-60268.*
DFD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC-60268*
Measurement Range	0 to 20%	
Accuracy	±0.5 dB	
Residual IMD[1, 7]		
SMPTE & MOD		*Typically <–140 dBFS*
DFD		*Typically <–150 dBFS*
Frequency Measurement		
Range	<5 Hz to 0.499 • SR	
Accuracy	±(0.0003% + 100 µHz)	
Resolution	6 digits	
Phase Measurement		
Ranges	–90 to +270, ±180, or 0 to 360 deg	
Accuracy[1]		*Typically 0.001 deg*
Resolution	0.001 deg	

Characteristic	Specifications	Supplemental Information
GENERAL/ENVIRONMENTAL		
Power Requirements	100, 120, 230 or 240 Vac, 50–60 Hz, with safety ground via approved power cord, 75 VA max.	*Typical operating range is 90–110 Vac (100V), 108–132 Vac (120V), 198–242 Vac (230V), or 216–264 Vac (240V).*
Temperature Range		
Operating	0° C to +45° C	
Storage	–40° C to +75° C	
Humidity	90% to +40° C (non-condensing)	
Max Operating Altitude	3,000 m	*Derate max operating temperature to +40°C at altitudes above 2,000 m*
Stabilization Time	20 minutes	*Allow at least 60 minutes if unit has been stored in a significantly different environment prior to turn on, or if unit is to be calibrated or adjusted*
EMC	IEC 61326-1:2005 / EN 61326-1:2006. Complies with EC Council Directives 2004/108/EC and 93/68/EEC.	*Emission and immunity levels are influenced by the shielding performance of interface and signal cables attached to the instrument. EMC compliance was demonstrated using Audio Precision cables*
Safety	IEC 61010-1:2001 / EN 61010-1:2001, CAN/CSA-C22.2 No. 61010-1-04, and UL Std No. 61010-1 (2nd Edition). Complies with EC Council Directives 2006/95/EC and 93/68/EEC.	*Equipment Class I, Installation Category II, Pollution Degree 2, Measurement Category I*
Dimensions		
Width	370 mm (14.55 inches)	
Height	86 mm (3.40 inches)	*2U rack mount tray available.*
Depth	343 mm (13.53 inches)	*Increase by ≈8mm [0.3 inches] if rear panel option keys are installed*
Weight	4.2 kg [9.1 lbs]	

Notes to Specifications

1. System specification including contributions from both generator and analyzer. Generator-only and/or analyzer-only contributions are typically less.
2. Generator load must be ≥ 600 Ω balanced or ≥ 300 Ω unbalanced for specified performance. Generator dc offset must be off or set to ≤10 mV.
3. Analyzer input must be ≥150 mV for specified performance. Analyzer set to measure "d2+d3" IMD products for MOD and DFD modes.
4. Valid for the balanced input configuration with dc coupling only. With ac coupling, specified performance is invalid below 50 Hz.
5. Maximum low-pass filter frequency is limited by analyzer input bandwidth setting.
6. Sample rate (SR) must be ≥ 27 kS/s for specified performance. Jitter analyzer set for 700 Hz highpass response per AES3-1992.
7. Digital generator word width must be set to 24 bits for specified performance; shorter word widths may degrade performance.

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